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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/798,144 | 03/10/2004 | Young Hoon Park | YPL-0085 | 5533 |

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| EXAMINER | |
|---|---|
| LIN, JAMES | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 1762 | |

DATE MAILED: 05/19/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/798,144 | PARK ET AL. | |
| | Examiner | Art Unit | |
| | Jimmy Lin | 1762 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) 1-24 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-24 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 10 March 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 112*

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 7 and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is indefinite if step 4'-3 is performed after step 4-3 or after a new dummy wafer is loaded on the wafer block.

### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 1 – 4, 7, 13 – 16, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park (2002/0007790) in view of Hillman (5,997,649) and Xuechun et al. (6,274,500).

6. Regarding claim 1, Park discloses an ALD thin film deposition equipment including a wafer block 140 inside reactor 100, a heater H installed in the wafer block to maintain the wafer block at a predetermined temperature during deposition (paragraph 35), and a shower head plate 120 (i.e., a lid). A main O-ring 114 is installed on the upper surface of the reactor block 110 so that the reactor block 110 and the shower head plate 120 are securely sealed (paragraph 28).

Although Park teaches first and second reaction gas supply lines and first and second inert gas supply lines to the showerhead, there is no explicit teaching of a shower head with first and second spray holes. However, it is implicit in the first and second reaction gas supply lines that the reaction gases are sprayed separately into the shower head. Inert gas is supplied after each reaction gas is sprayed to remove any residue reaction gas in the shower head. Hillman discloses a showerhead that is designed for introducing two different gases without mixing the two gases prior to the process space (column 10, lines 30 – 44), is biased with RF energy, and is electrically isolated from the metal reaction chamber body and lid (column 3, lines 54 – 56). In particular, the showerhead shown in Fig. 3 has first and second spray holes. It would have been obvious to one of ordinary skill in the art at the time of invention to use the showerhead of Hillman in the reactor of Park. One would have been motivated to do so with the expectation of keeping the reaction gases separated during the ALD process.

Park discloses a cleaning method for the ALD reactor due to byproduct deposition on the inner wall or component of the reactor and that the characteristics of the thin film can be deteriorated by said byproducts, but does not explicitly teach a cleaning method using an inert gas and cleaning gas in combination with RF power to the showerhead. However, Xuechun et al. discloses an in situ method of cleaning a plasma etch chamber, wherein a dummy wafer is loaded into the chamber, the cleaning gases are injected into the chamber, a radio frequency is applied, the dummy wafer is unloaded from the chamber, He gas is blown through the chamber (i.e., spraying an inert gas and purging the inside of the reactor) (claim 1 and column 6 lines 30 – 37). Residual reaction products are deposited on exposed surfaces in the plasma treatment chamber and the build-up of these residues deteriorate the performance of the process (column 2, lines 32 – 44). Thus, it would have been obvious to one of ordinary skill in the art at the time of invention to apply the in-situ plasma cleaning method disclosed by Xuechun et al. to a process chamber disclosed by Park in view of Hillman. One would have been motivated to do so in order to periodically clean the process chamber to avoid wafer defects and subsequent device failure.

7. Regarding claim 13, Park teaches that the wafer block is kept at a temperature of about 425 – 650 °C during the ALD film deposition process (paragraph 41).

Park in view of Hillman and Xuechun et al. teaches an in-situ plasma cleaning process of the reaction chamber and is silent to heating the wafer block during the cleaning. Thus, the temperature of the wafer block during the cleaning process will be reduced to a temperature lower than when the ALD film is deposited, since heat to the

wafer block is no longer required. In addition, the temperature of the wafer block will be raised back to about 425 – 650 °C when the cleaning process is done and the ALD film deposition begins.

While, Park in view of Hillman and Xuechun et al. does not explicitly teach that the susceptor is heated at the same time the reactor chamber is purged, the art teaches heating the susceptor and purging the chamber reactor. Performing these two steps at the same time would save time. Thus the combined steps would have been an obvious modification.

8. Regarding claims 2 and 14, Park discloses a shower head with a plurality of nozzles 133 (i.e., gas curtain holes) which face the inner sidewall of the reactor block 110 to spray a second reaction gas and/or inert gas onto the edges of the wafer block 140 (paragraph 30).

9. Regarding claims 3 and 15, Park in view of Hillman and Xuechun is discussed above, but does not disclose that the cleaning gas is being sprayed via any one group of holes among the first spray holes, the second spray holes, and the gas curtain holes, and the inert gas is being sprayed via the remaining holes. However, the art does suggest spraying the cleaning and inert gases through separate holes as established above and the purpose of the inert gas is as a purge gas and the cleaning gas is for cleaning the chamber. Hence, any manner of providing the gases through the separate groups of holes would result in the gases being introduced in the chamber and achieving their intended purpose. Therefore, providing the cleaning and inert gases in the claimed manner would have been obvious with a reasonable expectation of it being

operable for cleaning and purging the chamber, especially absent evidence showing a criticality for supplying the gases in the manner claimed.

10. Regarding claims 4 and 16, Xuechun et al. teaches that a first and second RF power is applied during the plasma cleaning steps (Fig. 2).

11. Regarding claims 7 and 19, Xuechun et al. teaches that the dummy wafer is loaded before the cleaning process begins (Fig. 1).

12. Claims 10 and 22, are rejected under 35 U.S.C. 103(a) as being unpatentable over Park (2002/0007790) in view of Hillman (5,997,649) and Xuechun et al. (6,274,500), as applied to claims 1 and 13 above, and further in view of Londergan et al. (6,720,259).

Park in view of Hillman and Xuechun et al. is discussed above, but does not teach that the ALD thin film is formed of one selected from the group consisting of $Al_2O_3$, $HfO_2$, and $ZrO_3$. Londergan et al. teaches that the deposition of $ZrO_2$ and $HfO_2$ is common in ALD (column 3, lines 53 – 64). Thus, one of ordinary skill in the art at the time of invention would have known to deposit an ALD thin film formed of $ZrO_2$ and $HfO_2$. One would have been motivated to do so in order to apply a high-k layer on a substrate to act as an etch stop.

13. Claims 11 – 12, 23, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park (2002/0007790) in view of Hillman (5,997,649) and Xuechun et al. (6,274,500), as applied to claims 1 and 13 above, and further in view of Ji et al. (2004/0014327).

14. Regarding claims 11 and 23, Park in view of Hillman and Xuechun et al. is discussed above, but does not explicitly teach the use of $BCl_3$ cleaning gas and Ar and $N_2$ inert gases. Ji et al. discloses that $BCl_3$ can be used for plasma cleaning of high-k materials (example 1). Since the chlorides of the high-k materials are more volatile, it is preferred to convert these high-k substances into chlorides. Chlorine-containing reactive gases that also contain oxygen-getter functions are preferred because the oxygen-getter component (B) in $BCl_3$ extracts oxygen from the high-k materials and hence enhances the conversion of metal oxides and metal silicates into metal chlorides (paragraph 30). Thus, it would have been obvious to one of ordinary skill in the art at the time of invention to use $BCl_3$ as a cleaning gas. One would have been motivated to do so with the expectation of enhancing the conversion of metal oxides and metal silicates into metal chlorides.

Ji et al. also discloses that inert gases such as nitrogen and argon can be added to modify the plasma characteristics and cleaning processes to better suit some specific applications (paragraph 31).

15. Regarding claims 12 and 24, Ji et al. teaches that the in situ plasma is operated at 2.5 mTorr to 100 Torr (paragraph 34). In addition, higher etch rate was achieved at reduced pressure, and lower pressure leads to faster desorption and diffusion of reaction byproducts (paragraph 53). There is no evidence indicating pressures of 2 Torr or less are critical. Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. See In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Thus, it would have been obvious to one of ordinary skill in the art at the time of invention to find the optimal pressure by routine experimentation.

Park teaches that Ar gas can be supplied at 50 sccm or greater (paragraph 82).

Xuechun et al. teaches that cleaning gas can be supplied at flow rates of 50 and 75 sccm (Tables in column 5).

16. Claims 5, 6, 8, 17, 18, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park (2002/0007790) in view of Hillman (5,997,649) and Xuechun et al. (6,274,500), as applied to claims 1 and 13, and further in view of Wing et al. (6,397,861).

17. Regarding claims 5, 6, 8, 17, 18, and 20, Park in view of Hillman and Xuechun et al. is discussed above, but does not teach RF power supplied to the showerhead and wafer block. However, Wing et al. teaches a plasma cleaning method wherein 100 to 1000 watts of an RF power is supplied to the chuck and showerhead to form plasma (column 6, lines 48 – 65), forming an anode and cathode (column 3, lines 40 – 42). The cleaning gas passing through the plasma is ionized and cleans the processing chamber, including the inside of the showerhead (column 2, lines 23 – 64). Thus, it would have been obvious to one of ordinary skill in the art at the time of invention to apply an RF power to the showerhead and chuck. One would have been motivated to do so in order to clean the processing chamber as well as the inside of the showerhead.

The RF power supplied to the chuck would inherently remove a thin film deposited on a surface of the chuck by using the activated cleaning gas.

18. Claims 10 and 22, are rejected under 35 U.S.C. 103(a) as being unpatentable over Park (2002/0007790) in view of Hillman (5,997,649), Xuechun et al. (6,274,500), and Wing et al. (6,397,861), as applied to claims 1, 6, 13, and 18 above, and further in view of Londergan et al. (6,720,259).

19. Regarding claims 9 and 21, Park in view of Hillman, Xuechun et al., and Wing et al. is discussed above, but does not teach a first pre-coating step performed before the dummy wafer is loaded on the wafer block and a second pre-coating step performed after the dummy wafer is loaded on the wafer block. However, Londergan et al. discloses a method of depositing a passivation layer on an ALD reactor to improve uniformity of a film layer deposited on a substrate resident in a reactor chamber (column 2, lines 58 – 61). The passivation layer can be deposited before the cleaning process (i.e., before the dummy wafer is loaded on the wafer block), with respect to the next scheduled cleaning process. Or the passivation layer can be deposited after the cleaning process (i.e., after the dummy wafer is loaded, and then unloaded), with respect to the prior cleaning process. Thus, it would have been obvious to one of ordinary skill in the art at the time of invention to deposit a passivation layer of Londergan et al. in the reactor of Park. One would have been motivated to so with the expectation of improving the uniformity of the film layer deposited on the substrate.

***Conclusion***

20. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Chae et al. (6,478,872) discloses a method of gas delivery into

reaction chamber. Umotoy et al. (6,086,677) discloses a dual gas faceplate for a showerhead. Umotoy et al. (6,079,356) discloses a CVD reactor.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jimmy Lin whose telephone number is 571-272-8902. The examiner can normally be reached on Monday thru Thursday 8 - 5:30 and Friday 8 - 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tim Meeks can be reached on 571-272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

05/10/2006
JL

SUPERVISORY PATENT EXAMINER
TIMOTHY MEEKS